

***Connecting STEM Research and Learning
Communities of the 21st Century:
Exploring Models of Collaborative Outreach***

William J. Frascella

Director

***Division of Elementary, Secondary &
Informal Education***

National Science Foundation





Connecting STEM Research and Learning Communities of the 21st Century

- ***As an Idea Problem: Transform and Transfer Content of STEM Research into Appropriate Educational Settings***
- ***As a Tools Problem: Develop Instructional Materials and Infrastructure to Support Transformed Content***
- ***As a People Problem: Develop a Corps of Teachers Qualified to Deliver Instruction of Transformed Content***



Collaboration: Essential Yet Elusive

- ***Addressing These Problems Requires the Collaboration of a Wide Range of Expertise from Science and Education***
- ***Requires Understanding the Institutional Settings of Both These Communities***
- ***Both Communities Are Undergoing Changes as Institutions***



The Challenge of Collaboration : the Emotional Pre-Requisites

- ***Robust Sense of Self-Interest Being Served***
- ***Mutual Respect***
- ***Trust***



- *Powerful Institutional Transformations of The Learning Community and STEM Research Workforce*
- *Stovepipe Structures are Weakening as Networks are Emerging*



Purposes and Policies Driving Changes in Both Communities: Urging Partnerships

- ***Insuring Future Capacity of the Research Workforce***
- ***Economic Competitiveness and General Workforce Issues***
- ***Greater Access to STEM-Related Jobs***
- ***Need for Societal Support for Big Science***
- ***Criteria of the National Science Board***



The Learning Communities of the 21st Century as a Network



Some U.S. PreK-12 Statistics

- *16,850 School Districts*
- *80,000 Schools*
- *3 million Teachers (FTE)*
- *46 million Students (K-12)*



21St Century Learning Communities U.S. Elementary (K-5)

- ***52,000 Schools***
- ***1.4 million Teachers***
- ***22 million Students***



21St Century Learning Communities Secondary (~6 - 12)

- ***29,000 Schools***
- ***1,230,000 Teachers***
- ***120,000 Science Teachers***
- ***23,000,000 Students***



Informal Education

<u><i>Museums (all types)</i></u>	<u><i>16,000</i></u>
■ <i>History</i>	<i>25% (4,016)</i>
■ <i>Art</i>	<i>23% (3,680)</i>
■ <i>Historic Home/Site</i>	<i>12% (1,872)</i>
■ <i>Natural History/Anthro</i>	<i>4% (672)</i>
■ <i>Science Centers</i>	<i>4% (608)</i>
■ <i>Children's/Youth</i>	<i>3% (560)</i>
■ <i>Zoos and Aquaria</i>	<i>3% (496)</i>
■ <i>Others ...</i>	

■ Source: Museum Financial Information 2003, American Association of Museums



Science-rich Informal Institutions: Some Comparisons

- ***~ 2000 institutions***

***Science Centers, Planetariums, Zoos,
Aquaria, Natural History Museums, Children
Museums, Nature Centers, Arboretums and
Botanical Gardens***

- ***25.8 million schoolchildren served
annually***

About 40% of all U.S. Children



21st Century Learning Communities Other Network Nodes

■ **Home Schooling**

- ***1,900,000 students***

■ **Charter Schools (in 37 states and the DC)**

- ***1,993 schools **** 17,477 teachers***

■ **Before/After School Program**

- ***6,000,000 students***



21st Century Learning Communities Issues Driving Change and Policy

- ***Over 28 Million School-Age Children
Have Both Parents in the Workforce***
- ***Over 5 Million School-Age Children
are Left Alone Each Week***



Networks of Connections: Model of the Learning Community

- ***Boundaries Becoming Blurred as New Connections Established***
- ***Dealing With a Network with Nodes and Connections***
- ***Informal Education (esp. Science Centers) Can Play a Leadership (Hub) Role in this Network***



The STEM Research Workforce of the 21st Century as a Network



STEM Research Workforce: Two Dimensions of Emerging Diversity

Horizontal Diversity

- ***Interdisciplinary Research Agendas Becoming Common***
- ***Science and Engineering Boundary Blurred***
- ***Collaborations among University, Business, and Government Driving This Diversity***



STEM Workforce: Two Dimensions of Emerging Diversity Research

Vertical Diversity

- ***Rapid Progress in Cyberinfrastructure and Internet Networking Responsible for Another Dimension of Diversity***
- ***Pursuing a Research Agenda Involves Workers With Wide Variety of Skills and Education***
- ***A Globally Distributed Workforce Can Pursue a Single Research Agenda***
- ***This Change is Transforming the Workplace of Research***



Networks of Connections

- ***Both Education and Science Are Emerging as Networks of Connections***
- ***Stovepipe Structures Are Dissolving in Both Networks***
- ***Policies, Interacting with a Variety of Purposes (from Business, Government, University, and STEM Disciplinary Agendas) are Driving The Development of These Networks***
- ***Research is Critical to Understand These Connections; and a***
- ***Rich Understanding of These Connections Is Crucial to the Research and Development of Outreach Structures to Connect These Networks***



The Grid Environment and a Unique Opportunity for Collaboration

- ***The Climate for Science and Science Education Collaborating Has Never Been Better***
- ***Each Side Will Set a High Priority on Solving Learning and Communication Problems***
- ***Self Interest of Scientists and Science Educators Can Drive an Effective Collaboration***



The Enabling Power of a Grid Environment and a Model of Collaborative Outreach: E-Laboratory

- ***An E-Science Laboratory as a Vehicle for Outreach***
- ***E-Laboratory Can Provide Rich Access to the Process as Well as Ideas of STEM Research***
- ***Engagement with Science of a Wide Range of Students***